

What is claimed is:

1. A barrier movement operator comprising:
an A.C. induction motor coupled to the barrier for controlling
the movement of the barrier;
a source of mains A.C. operating voltage comprising a
frequency;
a motor control apparatus connected to the main operating
voltage and the induction motor and responsive to power control signals
from a controller for varying the effective frequency of the mains operating
voltage coupled to the induction motor; and
the controller responds to user commands and detected
conditions of the barrier for incrementally changing a speed of movement of
the barrier by generating power control signals to control the motor control.

2. A barrier movement operator in accordance with claim 1
wherein the motor control apparatus operates in synchronism with the
frequency of the mains A.C. voltage for varying the effective frequency of the
mains A.C. voltage applied to the motor.

3. A barrier movement operator in accordance with claim 1
wherein the power control signals of the controller are generated in
synchronism with the mains A.C. frequency.

4. A barrier movement operator in accordance with claim 1
wherein the motor control apparatus comprises circuitry, responsive to the

power control signals for varying the effective voltage of the mains A.C. voltage coupled to the motor.

5. A barrier movement operator in accordance with claim 4 wherein the power control signals are generated by the controller in synchronism with the frequency of the mains A.C. voltage.

6. A barrier movement operator in accordance with claim 1 the motor comprising a rotor for rotating to a first direction and a second direction.

7. A barrier movement operator in accordance with claim 6 comprising direction apparatus for energizing the motor to selectively rotate the rotor in the first or the second direction.

8. A barrier movement operator in accordance with claim 7 wherein the direction apparatus connects the motor control apparatus to the motor.

9. A barrier movement operator in accordance with claim 7 wherein the controller generates motor direction signals for the selective control of the direction apparatus.

10. A barrier movement operator in accordance with claim 1 wherein the mains A.C. operating voltage comprises a recurring sequence of half cycles of alternating polarity occurring at a frequency.

11. A barrier movement operator in accordance with claim 10 wherein the effective frequency of the mains A.C. is coupled to the motor for a portion of every Nth half cycle where N is an odd integer greater than 1.

12. A barrier movement operator in accordance with claim 11 wherein the power of mains A.C. coupled to the motor is increased by increasing the portion of every Nth half cycle from a predetermined minimum amount to a predetermined maximum amount.

13. A barrier movement operator in accordance with claim 11 wherein the effective voltage of the mains A.C. coupled to the motor is periodically increased by incrementally increasing the portion of every Nth half cycle.

14. A barrier movement operator in accordance with claim 13 wherein the incremental increasing continues until all half cycles are coupled to the motor.

15. A barrier movement operator in accordance with claim 12 where the barrier is moved between first and second positions and the predetermined maximum amount for increasing the portion of half cycles is greater when the barrier is moving toward the first position than when the barrier is moving toward the second position.

16. A barrier movement operator in accordance with claim 15 wherein the first position is an open position and the second position is a closed position.

17. A barrier movement operator in accordance with claim 6 comprising apparatus for sensing a rotational speed of the rotor and the controller responds to the sensed rotor speed to generate the power control signals.

18. An A.C. induction motor control apparatus comprising:
an A.C. induction motor;
a source of mains A.C. operating voltage comprising a frequency;

a motor control circuit connected to the mains voltage and the induction motor and responsive to power control signals from a controller for varying the effective frequency of the mains operating voltage coupled to the induction motor; and

the controller includes a program for incrementally changing a rotational speed of the induction motor by generating power control signals to control the motor control circuit.

19. An A.C. induction motor control apparatus in accordance with claim 18 wherein the controller senses the A.C. mains voltage and operates in synchronism with the frequency of the mains A.C. voltage for varying the effective frequency of the mains A.C. voltage applied to the motor.

20. An A.C. induction motor control apparatus in accordance with claim 18 wherein the motor control circuitry comprises gating circuitry, responsive to the power control signals for varying the effective voltage of the mains A.C. coupled to the motor.

21. An A.C. induction motor control apparatus in accordance with claim 18 the motor comprising a rotor for rotating to a first direction and a second direction.

22. An A.C. induction motor control apparatus in accordance with claim 21 comprising direction apparatus for energizing the motor to selectively rotate the rotor in the first or the second direction.

23. An A.C. induction motor control apparatus in accordance with claim 22 wherein the direction apparatus connects the motor control apparatus to the motor.

24. An A.C. induction motor control apparatus in accordance with claim 22 wherein the controller generates motor direction signals for the selective control of the direction apparatus.

25. An A.C. induction motor control apparatus in accordance with claim 21 comprising apparatus for sensing a rotational speed of the rotor and the controller responds to the sensed rotor speed to generate the power control signals.

26. An A.C. induction motor control apparatus in accordance with claim 18 wherein the mains A.C. operating voltage comprises a recurring sequence of half cycles of alternating polarity occurring at a frequency.

27. An A.C. induction motor control apparatus in accordance with claim 26 wherein the effective frequency of the mains A.C. operating

voltage is coupled to the motor for a portion of every Nth half cycle where N is an odd integer greater than 1.

28. An A.C. induction motor control apparatus in accordance with claim 27 wherein the power of mains A.C. operating voltage coupled to the motor is increased by increasing the portion of every Nth half cycle from a predetermined minimum amount to a predetermined maximum amount.

29. An A.C. induction motor control apparatus in accordance with claim 27 wherein the effective voltage of the mains A.C. coupled to the motor is periodically increased by incrementally increasing the portion of every Nth half cycle.

30. An A.C. induction motor control apparatus in accordance with claim 29 wherein the incremental increasing continues until all half cycles are coupled to the motor.

31. A barrier movement operator comprising:
an A.C. induction motor coupled to the barrier for controlling the movement of the barrier;

a source of mains A.C. operating voltage comprising a frequency;

a motor control apparatus connected to the main operating voltage and the induction motor and responsive to power control signals from a controller for varying the effective frequency of the mains operating voltage coupled to the induction motor; and

the controller responds to user commands and detected conditions of the barrier for incrementally changing a speed of movement of the barrier by generating power control signals to control the motor control.

32. A barrier movement operator in accordance with claim 31 wherein the motor control apparatus operates in synchronism with the frequency of the mains A.C. voltage for varying the effective percentage of line voltage and sub harmonics of the mains A.C. voltage applied to the motor.

33. A barrier movement operator in accordance with claim 31 wherein the power control signals of the controller are generated in synchronism with the mains A.C. frequency.

34. A barrier movement operator in accordance with claim 31 wherein the motor control apparatus comprises circuitry, responsive to the power control signals for varying the effective voltage of the mains A.C. voltage coupled to the motor.

35. A barrier movement operator in accordance with claim 31 wherein the mains A.C. operating voltage comprises a recurring sequence of half cycles of alternating polarity occurring at a frequency.

36. A barrier movement operator in accordance with claim 35 wherein the effective wave shape of the mains A.C. voltage is coupled to the motor for a portion of every Nth half cycle where N is an odd integer greater than 1.

37. A barrier movement operator in accordance with claim 36 wherein the power of mains A.C. coupled to the motor is increased by increasing the portion of every Nth half cycle from a predetermined minimum amount to a predetermined maximum amount.

38. A barrier movement operator in accordance with claim 36 wherein the effective voltage of the mains A.C. coupled to the motor is periodically increased by incrementally increasing the portion of every Nth half cycle.

39. A barrier movement operator in accordance with claim 38 wherein the incremental increasing continues until all half cycles are coupled to the motor.

40. A barrier movement operator in accordance with claim 37 where the barrier is moved between first and second positions and the predetermined maximum amount for increasing the portion of half cycles is greater when the barrier is moving toward the first position than when the barrier is moving toward the second position.

41. An A.C. induction motor control apparatus comprising:
an A.C. induction motor;

a source of mains A.C. operating voltage comprising a frequency;

a motor control circuit connected to the mains voltage and the induction motor and responsive to power control signals from a controller for varying the effective percentage of the mains voltage and sub-harmonics thereof coupled to the induction motor; and

the controller includes a program for incrementally changing the speed of the barrier by generating power control signals to control the motor control circuit.

42. An A.C. induction motor control apparatus in accordance with claim 41 wherein the controller senses the A.C. mains voltage and operates in synchronism with the mains A.C. frequency for varying the effective percentage of the mains voltage and sub harmonics applied to the motor.

43. An A.C. induction motor control apparatus in accordance with claim 41 wherein the motor control circuitry comprises gating circuitry, responsive to the power control signals for varying the effective power of the mains A.C. voltage coupled to the motor.

44. An A.C. induction motor control apparatus in accordance with claim 41 wherein the mains A.C. operating voltage comprises a recurring sequence of half cycles of alternating polarity occurring at a frequency.

45. An A.C. induction motor control apparatus in accordance with claim 44 wherein the effective wave shape of the mains A.C. operating voltage is coupled to the motor for a portion of every Nth half cycle where N is an odd integer greater than 1.

46. An A.C. induction motor control apparatus in accordance with claim 45 wherein the power of mains A.C. operating voltage coupled to the motor is increased by increasing the portion of every Nth half cycle from a predetermined minimum amount to a predetermined maximum amount.